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SOVIET RIVER SHIPBUILDING AND VESSEL CLASSIFICATION

[Comment: This report presents excerpts from Chapters 1, 3, 14, and 19 of the book Osnovy Teorii i Ustroystva Sudov Vnutrennego Plavaniya (Fundamentals of Theory and Structure of Ships for Inland Navigation), by A. P. Strakhov, published in Moscow in 1955.]

Historical Development of River Shipbuilding

The developing national economy of the USSR, after the Revolution, required a considerable increase in transportation by the river fleet. The reconstruction of the river fleet began, therefore, in 1925.

Capital repair and reconstruction of the passenger fleet for the Volga, Dnepr, Northern, and other basins were begun in 1927 and 1928 and were continued for about 7-10 years. Several dozen large cargo-passenger vessels were overhauled during these years, or more correctly, were practically built anew.

Small series (5-6 units each) of covered and open cargo barges for the Dnepr, Don, Kuban', and Selenga rivers were the first river vessels constructed during the Soviet era. All of these barges were riveted and built in sections. They were sent to a designated place as separate parts and assemblies where they were put together.

During the period from 1924 through 1932, as many as 150 metal cargo barges were built, including covered barges with a dead weight of 1,600 tons and decked barges with a dead weight of 3,100 tons.

In this same period, in connection with the development of petroleum transport on the Volga, the construction of an unrigged tanker fleet was begun and was widely expanded in the years 1932-1934. The construction of the first tanker barges in 1924 and 1925 was very similar to that of the riveted tanker barges which were built during the prerevolutionary years.

In 1927, Soviet designers worked out a new construction method for the assembly of tanker barge hulls -- the so-called longitudinal system of assembly. It differed by its simplicity of construction, its light weight, and the fact that it considerably increased the longitudinal strength of the barges. This system of assembly permitted an increase in size and dead weight of tanker barges to 12,000 tons.

In 1934, and experimental, all-welded, tanker barge, the Komsomolka Sudoplatova, was built. It had a dead weight of 6,000 tons, hull dimensions of 133 x 3.35 meters, and a loaded draft of 3 meters. In later years a series of such barges was constructed.

Next a series of gasoline barges of 4,000 tons' dead weight each was built.

The increase in petroleum transport on the Volga called for an increase in loading and unloading speeds, so floating oil transfer installations or "petroleum stations" were built.

In construction of the self-propelled fleet, river shipbuilding plants began series construction of paddle-wheel steam tugs of 150, 200, and 300 indicated horsepower in 1928, each series exceeding 50 units.

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In 1929, construction was begun of a large series of single-screw steam tugs (200 indicated horsepower), each carrying a single vertical steam engine. This vessel's hull dimensions are 22.9 x 5.5 x 2.3 meters, with a draft of 1.68 meters.

In 1931, construction of tugs with the same hull dimensions, but all-welded and of 150 and 300 indicated horsepower, was begun. Construction of paddle-wheel steam tugs, each of 400 horsepower and using an inclined steam engine, was begun in 1932.

In the years 1930-1934, paddle-wheel tugs of the Krasnyy Shakhter type (now Georgiy Dimitrov) were built on the Volga. Each had a capacity of 1,200 indicated horsepower and a triple expansion engine. Their hulls were riveted.

In 1934, the construction of a second series of exactly the same paddle-wheel steam tugs was begun, but with welded hulls (now, the Leninets series).

The first passenger vessels built on the Volga were a series of single-deck, tug-passenger paddle-wheel steamers of the Chuvashrespublika type, with a capacity of 120 indicated horsepower. They were on such rivers as the Sura, Vetluga, and Unzha. The dead weight of each steamer was 50 tons and it carried 120 passengers.

Other ships built on the Volga included the following:

1. In 1933 and 1934, a series of cargo-passenger paddle-wheel steamers of the Kaganovich type, with a capacity of 300 indicated horsepower, for the Moscow-Ufa line.

2. From 1934 to 1936, a series of cargo-passenger diesel ships of the Marshal Voroshilov type (propeller driven), with a capacity of 800 indicated horsepower, for the Molotov-Astrakhan' line.

3. In 1936, a series of passenger diesel vessels (propeller) for the Moscow Canal, including:

   a. Two-deck ships of the Iosif Stalin type with a capacity of 700 brake horsepower.
   b. Two-deck ships of the Kaminin type, with a capacity of 300 brake horsepower, for local lines.
   c. Single-deck ships of the Chkalov type, with a capacity of 150 brake horsepower, for local lines.

Other new types of vessels built in the USSR for the Volga River Include the following:

1. A series of large diesel cargo vessels with a dead weight of 3,500 tons, of the Gruziya type (the so-called Bol'shaya Danilikha).

2. A series of small diesel cargo vessels of the Abkhaziya type (the so-called Malaya Danilikha), with a dead weight of 2,150 tons, produced in the years 1934-1935.

3. A series of refrigerated diesel vessels with a dead weight of 1,000 tons.

4. A series of special unrigged two-deck garage barges, used for transport of trucks.

A considerable number of small ships were built at this same time, including cargo and tanker barges of 100, 200, and 250 tons' dead weight; dredge barges of 100 and 150 tons' dead weight; a group of steam tugs, mostly propeller driven, with a capacity of 150 and 200 indicated horsepower; gas generator tugs and passenger ships; and diesel tugs of 65 and 120 brake horsepower for the Dnepr-Bug Canal.

By 1941, there were 2.2 times as many self-propelled ships and 2.7 times as many unrigged ships as there were in the First Five-Year Plan.

During the Second World War, the river fleet suffered heavy losses -- more than 1,000 self-propelled vessels and more than 3,000 unrigged vessels were destroyed, sunk, or damaged. In September 1947, by government decision, an extremely large shipbuilding program was launched to restore and expand river transport. This program outlined the construction of a large number of ships, to be produced in series (with several dozen ships in each series).

The basic types of ships in this new program are as follows:

Tugs -- paddle-wheel steamers of 200 and 400 indicated horsepower, propeller-driven diesel vessels of 150, 300, and 600 brake horsepower, and propeller-driven steamers with 450 indicated horsepower capacity for lake service.

Self-propelled freighters -- diesel vessels with a dead weight of 1,000 and 2,000 tons and a capacity of 800 brake horsepower; diesel vessels with a lower dead weight.

Passenger vessels -- Moskvich-type propeller-driven diesel vessels of 150 brake horsepower; lake diesel vessels of 300 brake horsepower; paddle-wheel steamers of 450 indicated horsepower. In recent years, construction has begun of large diesel vessels of 800 and 1,200 brake horsepower and diesel-electric vessels of 800 and 2,250 brake horsepower.

Unrigged cargo vessels (barges) -- decked barges of 3,000 tons' dead weight; platform barges (cargo loaded on deck) of 300, 500, 800, 1,000, and 1,400 tons' dead weight; covered barges of 1,000 tons' dead weight. The construction of lake barges of 1,800 and 3,000 tons' dead weight was begun recently.

Petroleum tankers -- barges of 1,000 2,000 4,000, and 6.000 tons' dead weight, and petroleum pumping installations with a productivity of 1,000 cubic meters per hour.

Ships of the technical fleet -- steam suction dredges with a productivity of 150 and 250 cubic meters per hour and diesel suction dredges with a capacity of 350 cubic meters per hour. The construction of multibucket dredges with a productivity of 250 cubic meters per hour and single-bucket dredges with a productivity of 100 meters per hour began recently.

A large number of series of wood unrigged and stationary vessels (barges, landing stages, and so forth) have also been built.

Vessel Classification Societies

The first association for vessel classification was established in 1834 in England, and was named "Lloyd's Shipping Register."

In Russia in 1913, the "Association for the Classification of Maritime, River, and Lake Vessels " (Russkiy Register),was established to carry out the same functions as Lloyd's.

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After the Revolution, technical supervision, registration, and classification of vessels in the USSR were originally the responsibility of Glavvod (Main Administration of Water Transport). In 1923, in connection with the overhauling and construction of ships, these functions were transferred to the Rossiyskiy Registr, which was renamed Registr Soyuza SSR (USSR Register) in 1924.

The USSR register is an organ for government technical supervision over safe navigation by maritime, lake, and river ships which belong to the Soviet Union (other than the ships which sail under the military flag). The Register also carries out the classification of vessels.

Technical supervision by the Register for ships under construction or major overhaul includes inspection and approval of plans. This is aimed at ensuring quality construction, including fulfillment of requirements for safe navigation and the provision of necessary equipment and supplies. Technical supervision by the Register of ships already in operation is aimed at establishing that a ship answers all the requirements for safe navigation, safe and secure transporting of passengers and cargoes, and safety of the crew.

Every ship in inland navigation which is under the supervision of the Register undergoes a periodic inspection every 4 years. The inspectors of the Register determine the necessity of repairs to the hull, machinery, and boilers, and observe the completion of these repairs. They also control the provision of anchors, chain, spare parts for the machinery, life-saving equipment, and other supplies prescribed by the rules of the Register.

Classification of vessels by the Register is a further development of technical supervision and serves to define the soundness of a ship (from the point of view of hull strength), the reliability of its machinery operation, and its seaworthiness in relation to conditions encountered within its area of operation.

In 1939, the Register of the USSR was divided into two independent organs -- the Maritime Register USSR and the River Register USSR, each carrying out appropriate technical supervision and classification of sea, lake, and river vessels.

The registers develop and publish rules for construction of maritime, lake, and river ships.

Unlike rules of foreign classification societies, the rules of the register permit the adoption of new methods for computing vessel strength and new, advanced technology in shipbuilding and in marine boiler and engine construction. The rules of the register are based not only on operational experience of earlier constructed ships (as is the case with foreign societies), but on the achievements of domestic and international science and technology, augmented by practical observations.

On the basis of experience in planning, building, and operating new types of ships, the registers revise, improve, and publish systematic rules for constructing and equipping ships. The rules of the registers, however, do not forbid designing and planning new ships with deviations from the rules, if these deviations are verified by calculation and agreed to by the registers.

The registers speak with great authority among shipbuilders and water transport workers. All the complex problems of fleet planning, building, and repairing are solved with the participation of engineers from the register.

In the opinion of some, the requirements of the registers for building ships for internal navigation will be done away with in the future.

Classification of Ships by Operational Area.

According to operational area, ships sailing in inland waters are classified as suitable for: deep-water routes (large rivers); reservoirs or lake-type headwaters on large rivers; lakes and maritime roadsteads of large rivers; artificial waterways (canals); or small lines and small rivers.

In accordance with the conditions of navigation in the different areas of domestic waterways, all the ships of inland navigation are divided into four categories, which have been established by the River Register USSR.

Ships of category "M" are characterized by increased hull strength designed for navigation in waves 3 meters high and 40 meters in length. Ships of category "M" sail in great depths; therefore, increased draft is also characteristic.

Category "M" includes ships which sail from the Severnaya Dvina River into the White Sea as far as the Arkhangel'sk lightship; in Obskaya Guba from Novyy Port to Ostrov Shokal'skiy and in Tazovskaya Guba; in coastal navigation in Yeniseyskiy Zaliv from Ust'-Port to Ostrov Dikson and in Gydanskaya Guba; in the eastern part of the Gulf of Finland from Kronshtadt to Viborg; in Pechorskiy Zaliv from Nar'yan-Mar to the Ostrova Gulyayevskiye Koshki; along Amurskiy Zaliv, below Nikolayevsk-na-Amure; along the following lakes: Ladoga, Onega, Baykal, and Issyk-Kul'; and in the Aral Sea.

Ships of the category "O" are designed for sailing in waves 2 meters high and 20 meters long.

Category "O" includes ships which navigate in the following areas: Balkhash, Vyg-ozero, and Sevan lakes; in Kurskiy Zaliv to Grants, Ribach'ye, Nida; in the Rybinsk Reservoir; in the Dnepr-Bug estuary to Ochakov; in the Gulf of Finland, from Lentorgport (Leningrad Commercial Port) to Kronshtadt; on the Astrakhan' 16-foot roadstead; and in Obskaya Guba from the Yamsalskiy Bar to Novyy Port. This category also includes vessels operating in the lower parts of the large rivers, as follows: on the Lena below the mouth of the Aldan River to Bukhta Tiksi; on the Amur from Khabarovsk to Nikolayevsk-na-Amure; on the Yenisey from Igarka to Ust'-Port; on the Yuzhniy Bug below the Nikolayev; along the Kakhov Reservoir on the Dnepr; on the Volga from Kamskoye Ust'ye to Stavropol' (after construction of the Kuybyshev Reservoir begins) and from Saratov to Stalingrad (after the construction of the Stalingrad Resevoir begins) the Don from the Karpovskiye roadsteads to Tsimlyanskaya (along the Tsimlyanskaya Reservoir); on the Kama from Berezniki to Molotov (on the Molotov Reservoir); and from the mouth of the Vyatka River to the mouth of the Kama River (after construction of the Kuybyshev Reservoir begins). Thus, this category applies basically to new reservoirs, lower reaches of the large rivers, and small lakes.

Ships of category "R$^{\infty}$" are designed for navigating in waves that are 1.2 meters high and 12.5 meters long.

Category "R" includes ships sailing on lakes (Chud, Beloye, Il'men', Zaysan, and Kubenskoye), on the Moscow reservoir, and on rivers as follows: Volga from Kalinin to Kopring, from Shcherbakov to Gorodets (on the future Gor'kiy Reservoir), from Cheboksary to Kamskoye Ust'ye (on the upper parts of the future Kuybyshev Reservoir), from Stavropol to Stalingrad (on the upper parts of the future Stalingrad Reservoir), and from Stalingrad to the Astrakhan' Sea Canal; the Kama from Molotov to the mouth of the Vyatka River; the Ob' from Kamen' to Yamsal'skiy Bar; the Yenisey from Krasnoyarsk to Igarka; the Irtysh below Omsk;

the Lena from Vitim to the mouth of the Aldan River; the Dnepr below Dnepropetrovsk (along Lake imeni Lenin); the Severnaya Dvina from the Pinega River to Bar; the Neva, Kolyma, Yana, Indigirka, Angara, Aldan, Selenga, and Pechora (from Ust'-Tsil'ma to Nar'yan-Mar); the Amur from Blagoveshchensk to Khabarovsk; the Don from Rostov to the Moscow Canal; and the Yuzhnyy Bug from Nikolayev to the village of Ternovatoye. This category also includes ships operating in the Kurskiy Zaliv from Klaypeda to Nida; on the Veselovskoye Reservoir; the Canal imeni Moskva; and the Volga-Don Canal from Krasnoarmeysk to Kalach.

The ships of category "L" are designed for navigating in calm water, and have corresponding hulls. The draft of these ships is limited, in comparison with the previous types.

Category "L" includes ships which sail in the upper reaches of the large rivers as follows: the Lena above Vitim; the Yenisey above Krasnoyarsk; the Volga above Kalinin and from Gorodets to Cheboksary (as far as the Cheboksary Hydroelectric Power Station); the Dnepr above Dnepropetrovsk; the Pechora above Ust'-Tsil'ma; the Amur above Blagoveshchensk; the Severnaya Dvina above the mouth of the Pinega River; the Kama above Berezniki; the Ob' above Kamen'; the Irtysh above Omsk; and on the Shilik, Zeya, Amu-Dar'ya, Volkhov, Svir', Zapadnaya Dvina, Oka, Moscow, and Neman. Category "L" also includes ships which sail on canals and all other rivers which are not listed above.

Materials Used for Inland Shipbuilding

In the construction of vessels for inland navigation, the USSR uses St. 2, St. 3, St. 4, St. 4f, and St.5s steel. Most frequently, St.3 steel is used for the hulls of these vessels, but St. 4 steel is used for ships of Register categories "M" and "O."

Shipbuilding steel is manufactured in two basic classes: thin sheet (0.9-3.5 millimeters) and thick sheet (4 millimeters and up). Within the limits of 0.9-1.5 millimeters, thin sheet is produced in thicknesses through every 0.1 millimeter. Within the limits of 1.5-3.5 millimeters, it is produced in thicknesses through each 0.25 millimeter.

Thick sheet is produced in sizes through each 0.5 millimeter within the limits of 4-6 millimeters, through each one millimeter within the limits of 6-30 millimeters, and through each 2 millimeters over the 30-millimeter-thick size.

Three basic sheet sizes are used in the construction of ships for inland navigation: 1,250 x 2,500 millimeters, 1,400 x 2,800 millimeters, and 1,400 x 4,200 millimeters.

In addition to steel, the river shipbuilding industry uses aluminum and aluminum alloys, bronze, brass, cast iron, wood, and various finishing and insulating materials, such as plastics, cork, asbestos, and fibre glass.

Assembly-Line Methods in Shipbuilding

In large-series construction of medium and small river and maritime ships, barges, and launches, three methods of assembly-line production are employed: conveyer, line-position, and line-brigade.

The conveyer method is the one used chiefly for the construction of ships of small tonnage and especially in launch building. This method has been widely used in the USSR since the Civil War. With the conveyer method, ships are constructed on special trucks which are moved along rails, with periodic stops at certain positions where specialized brigades carry out assembly operations. The moving of the ships from one position to another at definite fixed intervals of

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time is called the conveyer's rhythm of work. The number of workers at each position depends on the size of the operation and the rhythm of the conveyer's operation. The period of time required to build a vessel is called the cycle of the conveyer or the cycle of construction.

The operations at each position are carried out by special brigades (shipfitters, welders, assemblers, plumbers, carpenters, cabinetmakers, painters, and others). The work is organized so that each man will systematically fulfill one, and only one, operation. The breaking of the rhythm of operations and the nonfulfillment of the tasks of any brigade according to schedule will stop the entire conveyer and lead to a forced standstill of the workers at all the remaining conveyer positions. In the conveyer construction system, the ship should be completely finished when it is launched from the last position. Once afloat, only propeller connections remain to be done, in addition to supplying and testing the ship.

The line-position method of ship construction is a variety of the conveyer method. This method has been applied and has become familiar in plants which build larger ships.

In the line-position method, as with the conveyer method, ships are moved from one position to another, but with the conveyer method the construction of the ship is carried out on trucks which are moved periodically. Therefore, the number of trucks must not be less than the number of positions in the conveyer. In the line-position method, the ships are assembled on non moving berths and only for the moving of the ship from one position to another is it placed on trucks or some other motive equipment.

A vessel under construction may be moved by any one of the following means:

1. Transporting trucks which are moved along rails. The load of the truck is determined by the last position where all machinery, assemblies, and fittings are installed. An inclosed section, which is usually assembled from flat bottom sections and assemblies on a separate production line, is placed on each truck. The finished ship, in most cases, is moved on several connected trucks.

2. Transporting trucks on wheels with rubber tires running on steel sheets and asphalt. The number of wheels on a truck depends on the demensions of the ship, with some trucks having as many as 32 wheels.

3. Length wise runners on which the hull of the ship and the sections which form it are moved on special wooden slides. In moving a section, the length wise runners are placed along the path of the production line, salted, and the section is moved along them with the aid of electric or steam winches.

The period of time in which the ships are moved from one position to another is called the rhythm of the production line. In the building of large ships the hull is moved once every week, 2 weeks, or even a month, depending on the program of the plant and its equipment and on the dimensions of the ship being built.

The line-brigade method is used in the building of both large and small ships in plants where conditions do not permit moving a vessel during its construction. With this method, the specialized brigades, having completed definite operations on one ship, change over to another, then to the next, and so forth.

At present, a mixed method is also used. In this case the line-brigade method is used at one position while the line-position or the conveyer method is used at another.

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